Application of Natural Polymer Extracted Moringa Oleifera in the Treatment of Drinking Water

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Abstract

In this work, we conducted a study on the extraction of natural polymer and use of natural polymer such as coagulating agent in the process of coagulation/flocculation for water treatment, which was carried out to study the removal of turbidity parameter. The natural polymer was extracted from the plant Moringa oleifera, and the extraction occurred in saline, and saline solutions were employed, so did the monovalent (KCl and NaCl) and divalent ($BaCl_2$, $CaCl_2$ and $MgCl_2$). Therefore, given that the laws are becoming increasingly rigid and the requirements of the standard improvement on health is increasingly drawn attention worldwide, water treatment coagulant using natural provides greater efficiency to water treatments. Thus the use of natural polymer such as coagulating agent extracted from Moringa oleifera amid saline $BaCl_2$ was more efficient in the removal of turbidity parameter reaching removal percentage of 99%, to water with starting turbidity of 50 and 150 y uT respectively .

Keywords

Polymer Natural Moringa Oleifera; Coagulation/Flocculation

Introduction

It is desirable that coagulants alternative, more environmentally acceptable and affordable, be used to complement (but not overwrite) the salts of aluminum, iron, and synthetic polymers. In this context, vegetable coagulants represent a viable alternative that has risen for treating water in developing countries (RAMOS, 2005).

The polymers of natural organic origin universally known as polyelectrolytes, are represented by compounds consisting of large molecular chains, endowed with sites with positive or negative charges (Borba, 2001). However, only the cationic polyelectrolytes, ie which have positive charges may be used without applying the primary coagulant (Spinelli, 2001). Natural polymers are those that exist in nature. The Moringa oleifera, which is a natural polymer, acts as a clarifying agent in water treatment because it contains a cationic protein which destabilizes the particles contained in the water in liquid medium through the process of neutralization and adsorption, and flocculate colloids followed by sedimentation. (Santos et al. 2009).

Moringa oleifera

The Moringa oleifera Lam represented in FIG. 1(a) and 1 (b), the most widespread species of the family Moringaceae, is a plant native to India, which has spread throughout the world, especially in tropical countries such as Brazil. In the north eastern Brazil Moringa oleifera is known as "White Lily" Borba (2001).

The Moringa studied as an alternative in water treatment and in accordance with DAVINO (1976), has a protein mechanism which causes coagulation / flocculation in water similar to the mechanism caused by polyelectrolytes which are polymers originating from proteins and polysaccharides of natural or synthetic origin.

Protein is the compound found in greater amounts, approximately 40%. It is reported in Moringa oleifera that the presence of a cationic dimeric protein of high molecular weight, destabilizes the particles contained in the water and by a process of neutralization and adsorption, the flocculate of colloid followed by sedimentation (NDABIGENGESERE et. Al. 1,995).

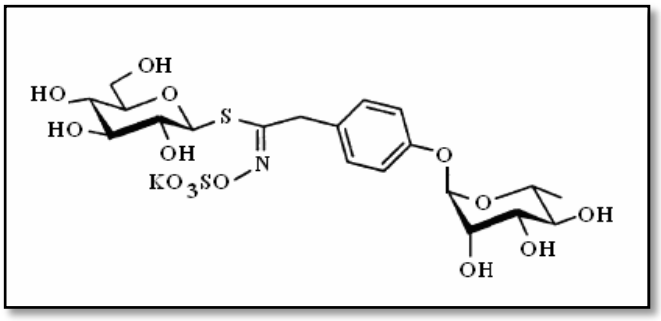
GUEYRARD et al. (2000) found that seed of Moringa contains between 8 and 10% of glucosinolates which are a class of combinations of homogeneous natural tiosacarídeos. These can be hydrolyzed by the enzyme

(A) PODS AND SEEDS

(B) TREE ADULT

Source: national meeting of moringa enam (2009).

FIG. 1 MORINGA OLEIFERA



Source: gueyrard et al. (2000).

FIG. 2 STRUCTURE OF GLUCOSINOLATE PRESENT IN THE SEED OF MORINGA

myrosinase and hence produce D-glucose Particularly isothiocyanates. FIG. 2 shows a possible structure of coagulant substance of the seed of Moringa oleifera.

The Moringa oleifera requires, however, more time for floc formation than other chemical coagulants (MATOS, 2007). According to Ndabigengesere et al., (1995), the active component of the polymer when Moringa oleifera is extracted is a protein in water. The polymer extracted from saline is not protein, polysaccharide or lipid, but an organic polyelectrolyte, with amino functional group and a hydroxy group (Okuda et al. 2001).

Methodology

The process of coagulation/flocculation applied to water to be treated, was evaluated for removal of turbidity parameter. Kaolin in water containing a concentration of 5g/L was prepared for distilled water. Water in the study was kept under stirring for 4 hours, and further diluted to obtain solutions turbidity and 150uT 50uT.

The extraction of active components from Moringa oleifera natural polymer coagulant was accomplished through the use of salt solutions of KCl, NaCl, $BaCl_2$, $CaCl_2$ and $MgCl_2$ at a concentration of 1 M. The extraction was performed by grinding 10 g of Moringa oleifera seed in a blender with a liter of saline each. Then, the solution was kept magnetically stirred for 20 minutes, filtered under vacuum, to obtain the extraction of active components from Moringa oleifera in saline at concentration of 1%.

With initial turbidity of 150 uT and 50 uT, according to the methodology described by the authors as MADRONA, 2010; Pavanelli, 2001; Pavanelli, 2002; MORAES, 2004; MORAES, 2009; DI BERNARDO, 1990. To represent low and high turbidity respectively, the maximum removal was set equal to 60 minutes (samples 1, 2, 4, 6, 8, 10, 20, 40 and 60 min), and tests were conducted with rapid mixing (100 rpm, 1 minute) and slow mixing (10 rpm, 10 minutes) with settling time of 60 minutes.

The turbidity was determined in HACH-2100 AN Turbidimeter. Turbidity is expressed in FAU - Formazing Atteenuation units, wherein one FAU, uT corresponds to one unit (turbidity), which corresponds to one NTU - Nephelometric Turbidity Units.

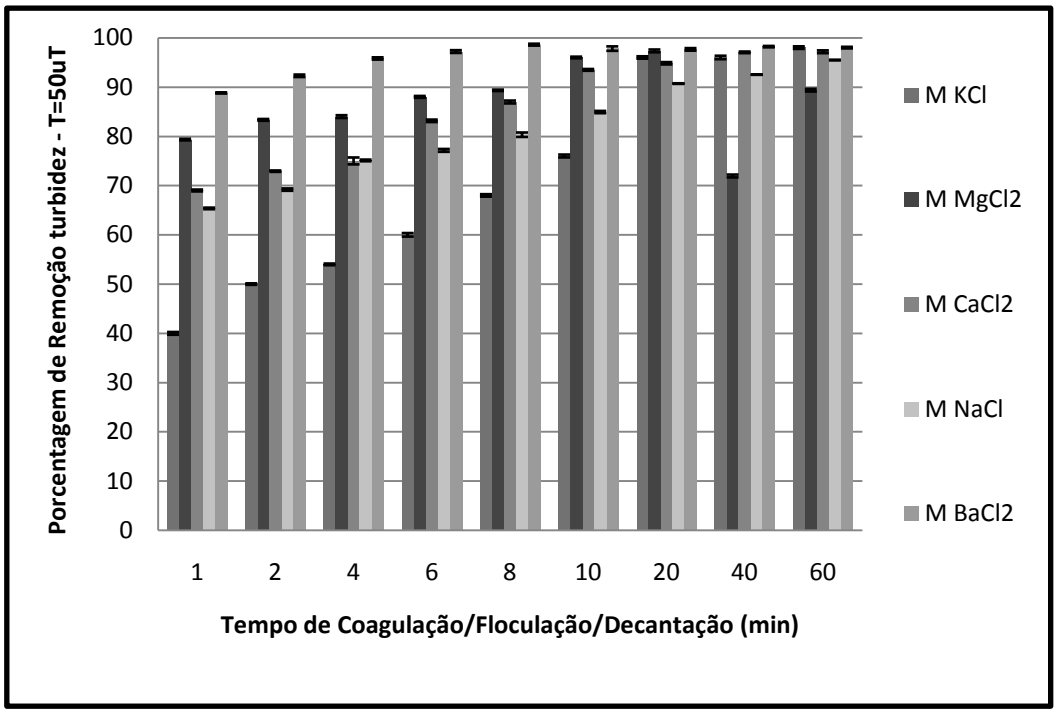


FIG. 3 PERCENTAGE REMOVAL OF TURBIDITY PARAMETER USING THE NATURAL POLYMER COAGULANT *MORINGA OLEIFERA*. T = 50 uT

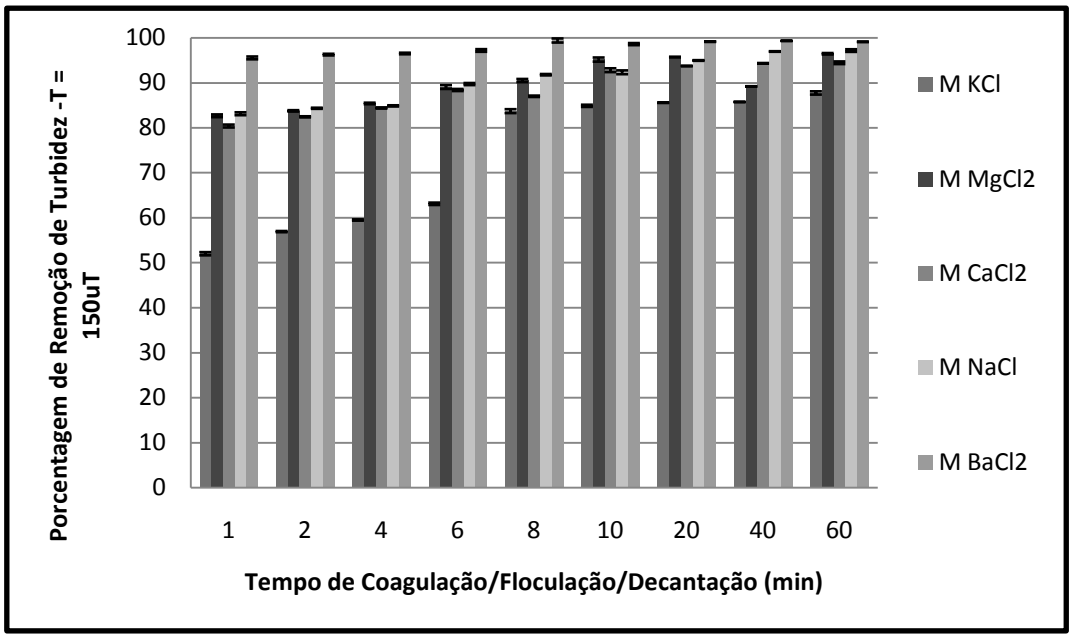


FIG. 4 PERCENTAGE REMOVAL OF TURBIDITY PARAMETER USING THE NATURAL POLYMER COAGULANT *MORINGA OLEIFERA*. T = 150 uT

Results

The results of the use of natural polymer in water tratammento for removing turbidity parameter are dispotos in FIG. 3 and 4, which show the percentages of removal of the parameter turbidity versus time.

It was observed from FIG. 3 and FIG. 4 that, for the time 8 min, the coagulant *Moringa oleifera* extracted with natural saline solution of $BaCl_2$ showed the best percentage removal of turbidity parameter (98.6%) and (99.40%) for water with turbidity initial 50 and 150 uT respectively. For these percentage removals, the residual turbidities were 0.70 uT and 0.90 uT, respectively.

For the time of 1 min, the natural coagulant Moringa oleifera extracted from saline solution in which KCl

had the lowest percentage removal of turbidity parameter 40% and 52% for the initial turbidity of 50 uT uT and 150, respectively.

The natural polymer extracted from *Moringa oleifera* in saline $BaCl_2$, showed the best performance in the removal of turbidity parameter. Regarding the time of coagulation / flocculation/sedimentation, the coagulant with the highest percentage removal in less time (1 min) of operation, was the *Moringa oleifera* ($BaCl_2$) to the turbidity of 150 uT.

Smith (2009) used the natural coagulant *Moringa oleifera* and noted that for water turbidity 50uT, removals were greater than 94% of turbidity. Nkurunziza et al. (2009) using solution of *Moringa oleifera* (3%), extracted with a solution of 1M NaCl, achieved a turbidity removal of 83.2% for the initial turbidity of 50 uT, and 99.8% for initial turbidity 450 uT.

The results of this study on high turbidity of 150 uT, were approximate the results obtained by other researchers who worked with low turbidity using the same natural coagulant Moringa oleifera as Madrona (2010), and Hening et al. (2007) found values of approximately 80% in turbidity, with a dosage of Moringa oleifera equivalent of 50mg / L in water of low color and turbidity. The dosage of coagulant to be used depends on the initial turbidity of the water, and to water of low turbidity standard solution of 50 mg / L is sufficient (Hening et al. 2007).

According to Ndabigengesere, Narasiah and Talbot (1995), seeds of *Moringa oleifera* from various forms of extraction and purification, have proven their efficiency in removing suspended and colloidal material, being the same in this study. According to Okuda et al. (2001), this is justified because proteins were found in the active component in Moringa oleifera seeds, high molecular weight, which act as natural organic polymers.

Considering the fact that the solubility of proteins increases with the salt concentration to lower values of the ionic strength of the salt, various extraction methods have employed salts (such as NaCl, KCl) in order to increase the solubility of the active compound in saline solutions (Okuda et al. 2001).

Conclusions

The natural polymer extracted from $BaCl_2$ saline showed more efficient than natural polymer extracted from *Moringa oleifera* among saline solutions of KCl, NaCl, $CaCl_2$ and $MgCl_2$.

The application of this natural polymer, reached removal of turbidity in the water treatment with an efficiency of 99% removal of tubidez reaching the limits allowed by the ordinances regulating parameters drinking water.

Despite the efficiency achieved in the use of natural polymer extracted amid saline， $BaCl_2$ in the process of removing the turbidity is not recommended in the operation of this procedure of extracting the natural polymer of *Moringa Oleifera*, for the treatment of drinking water, by virtue that $BaCl_2$ is an inorganic salt, classified as a toxic by ingestion and harmful by inhalation, according to the European directive 67/548/EEC, as amended. Therefore for the treatment of drinking water, it is necessary that the extraction of natural polymer is made by nontoxic salts, such as KCl, NaCl, $CaCl_2$ and $MgCl_2$.

From the conducted studies, it is observed that the use of natural polymers as coagulants in water treatment, proved to be an alternative technique, with promising potential in the removal of suspended solids. Thus the use of natural polyelectrolytes, should be more stimulated and enhanced through scientific research.

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